Rejections Under 35 U.S.C. 103

The Office Action rejects claims 20-39 as being obvious in view of the combined teachings of U.S. Patent No. 5,852,646 of Klotz and U.S. Patent No. 6,265,736 of Dillen.

Claim 20 is directed to a method of imaging a scene by irradiating the scene from a plurality of angular positions. The radiation transmitted through the scene is then detected *at a plurality of different spatial resolutions* corresponding to the plurality of angular positions. The detected radiation is then utilized to generate two-dimensional radiation transmission data that is representative of the intensity of the radiation transmitted through the scene at each of the plurality of the angular positions. A three-dimensional image of the scene is then created based on the two-dimensional transmission data.

Klotz describes an x-ray imaging method in which a first imaging device is utilized to form a series of processed two-dimensional x-ray images of an object, e.g., skull of a patient, under examination from different angular perspectives. A three dimensional image of the same object, e.g., an MR or a CT image, is formed by a second imaging device. A set of synthetic two-dimensional projection images corresponding to the measured two-dimensional images are extracted from the three-dimensional image by calculating respective two-dimensional projections of the three-dimensional image. Subsequently, the synthetic projection images and the measured two-dimensional images from the same perspectives are superposed to form a series of superposition images that are displayed to a viewer.

Dillen is directed to an image pick-up apparatus that includes an image sensor whose spatial resolution can be adjusted. The image sensor includes a CCD sensor having a matrix of gate electrodes positioned over a light sensitive substrate that can release charged particles, i.e., electrons or holes, in response to incident radiation. A control circuit can vary voltages applied to the gate electrodes to adjust the sensor's spatial resolution.

As noted by the Examiner, unlike the claimed invention, Klotz fails to teach or suggest employing different spatial resolutions for detecting radiation transmitted through the object at different angular positions. In particular, in Klotz, the plurality of the two-dimensional x-ray images, recorded by the first imaging device, are not obtained at different spatial resolutions.

Further, unlike the claimed invention, Klotz does not utilize the plurality of measured two-dimensional images to calculate a three-dimensional image. Rather, in Klotz, the three-dimensional image, which is obtained independently from the measured two-dimensional images, is employed to calculate a set of synthetic two-dimensional images that can be superimposed on the set of measured two-dimensional images. Hence, Klotz fails to teach or suggest material features of the claimed invention, and their concomitant advantages.

Moreover, there is no motivation for combining the teachings of Klotz with those of Dillen. Applicants note in this regard that an Examiner may only establish a *prima facie* case of obviousness when "the teachings from the prior art itself would appear to have suggested the claimed subject matter to a person of ordinary skill in the art." *In re Bell*, 991 F.2d 781, 783, 26 USPQ2d 1529, 1531 (Fed. Cir. 1993). In asserting that the prior art "suggested" the claimed subject matter, however, an Examiner must realize that "the mere fact that the prior art may be modified in the manner suggested by the Examiner neither makes the modification prima facie obvious nor obvious unless the prior art suggested the desirability of the modification." *In re Fritch*, 972 F.2d 1260, 1266, 23 USPQ2d 1780, 1783-84 (Fed. Cir. 1992). Moreover, the Examiner may not "use the claimed invention as an instruction manual or 'template' to piece together the teachings of the prior art so that the claimed invention is rendered obvious." *Id.*

In the present case, neither Klotz nor Dillen suggests generating a three-dimensional image of scene by detecting radiation transmitted through the scene at different spatial resolutions corresponding to different angular positions. In particular, as discussed above, Klotz is concerned with correlating a series of two-dimensional x-ray images obtained at different angular positions with a series of synthetic two-dimensional projections of a three dimensional image of the same object. Employing different spatial resolutions for obtaining the measured two-dimensional x-ray images in Klotz does not facilitate correlating these images with the respective synthetic two-dimensional images, but rather renders the correlation process more difficult. In particular, for each synthetic two-dimensional image, a different normalization corresponding to the resolution of the respective measured two-dimensional x-ray image needs to be employed.

Further, even if one combines the teachings of Klotz with those of Dillen, one does not obtain the claimed invention. In particular, Dillen simply describes a sensor whose resolution can be adjusted by application of voltages to a grid of gate collectors. Dillen does not teach the use of its sensor for obtaining x-ray transmission data at different angular positions in response to irradiation of an object. In other words, even if one employs the sensor of Dillen for obtaining the x-ray images of Klotz, one does not obtain the claimed invention because there is no teaching in either reference regarding changing the resolution of the sensor at each angular position for obtaining the series of the two-dimensional images, rather than obtaining all of the images in a given series with a selected resolution.

Thus, claim 20 distinguishes patentably over the combined teachings of Klotz and Dillen. Claims 21-27 depend either directly or indirectly on claim 20, and hence are also patentable.

System claims 28-34 are canceled without prejudice to expedite the prosecution of the present application. Applicants reserve the right to pursue these claims in future continuing applications.

Claim 35 recites a method of imaging an object by irradiating it from a plurality of *non-uniformly* distributed angular positions, and detecting radiation transmitted through the object for each of the angular positions to generate two-dimensional radiation transmission data. A three-dimensional image of the object is then constructed by analyzing the radiation transmission data.

Neither Klotz nor Dillen teaches or suggests irradiating an object from a plurality of non-uniformly distributed angular positions to obtain a plurality of two-dimensional images, and utilizing these two dimensional images to form a three-dimensional image of the object. Hence, the combined teachings of Klotz and Dillen fail to teach or suggest the subject matter of claim 35. Hence, claim 35, and claims 36, 37, and 38, which depend on claim 35, are patentable.

The arguments presented above with respect to claim 35 apply with equal force to establish that claim 37 also distinguishes patentably over the combined teachings of Klotz and Dillen.

New Claims

New claim 40, which depends on claim 37, not only incorporates the patentable features of claim 37 described above, but it also recites that the dose of radiation employed for each angular irradiation of the object is sufficiently low such that the total dose of irradiation is approximately 80 mrad.

Neither Klotz nor Dillen teaches or suggests employing a low dose of radiation for irradiating an object from a plurality of non-uniform angular positions to generate a two-dimensional data set that can then be analyzed to form a three-dimensional image of the object. Hence, claim 40 is patentable over the combined teachings of Klotz and Dillen.

Further, the arguments presented above apply with equal force to establish that new claims 41, 42, and 43 are also patentable over the combined teachings of Klotz and Dillen.

CONCLUSION

In view of the above amendments and remarks, Applicants respectfully request reconsideration and allowance of the application. If there are any remaining issues, Applicants invite the Examiner to call the undersigned at (617)439-2514 to expedite the prosecution of this application.

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Respectfully submitted,

By______________

Reza Mollaaghababa
Registration No.: 43,810
(617) 439-2514
(617) 310-9514
World Trade Center West
155 Seaport Boulevard
Boston, MA 02210-2169
Attorneys for Applicant

~~LISTING OF ALL PENDING CLAIMS~~

1. (Previously withdrawn) A system for imaging a scene, comprising:

a radiation source capable of emitting radiation toward a scene from a plurality of angular positions;

a variable spatial resolution detector positioned to detect radiation transmitted through the scene and producing radiation transmission data representative of the intensity of the radiation transmitted through the scene;

a resolution controller in electrical communication with the detector, the resolution controller varying the spatial resolution of the detector in response to the angular position from which the radiation is emitted by the radiation source toward the scene; and

an image processor in electrical communication with the detector, the image processor receiving the radiation transmission data from the detector and producing an image of the scene.

2. (Previously withdrawn) The system claim 1, wherein the plurality of angular positions from which the radiation source is capable of emitting radiation toward the scene defines an arc about the scene.

3. (Previously withdrawn) The system of claim 1, wherein the radiation source is movable, the system further comprising a first motion controller coupled to the radiation source, the first motion controller moving the radiation source to the plurality of angular positions with respect to the scene.

4. (Previously withdrawn) The system of claim 3, wherein the plurality of angular positions are located in a plane extending through approximately the center of the radiation source and approximately the center of the scene.

5. (Previously withdrawn) The system of claim 3, wherein the plurality of angular positions define an arc about the scene.

6. (Previously withdrawn) The system of claim 5, wherein the arc spans a plane and has an axis of rotation on a line in the plane that is perpendicular to the scene and that extends through approximately the center of the scene.

7. (Previously withdrawn) The system of claim 5, wherein the first motion controller moves the radiation source in a series of steps of varying angular spacing along the arc.

8. (Previously withdrawn) The system of claim 7, wherein the scene is defined by a plurality of horizontal planes and wherein the angular spacing of the steps decreases as the first motion controller moves the radiation source from a first angular position substantially parallel to the plurality of horizontal planes to a second angular position substantially perpendicular to the plurality of horizontal planes.

9. (Previously withdrawn) The system of claim 3, wherein the detector is movable, the system further comprising a second motion controller coupled to the detector, the second motion controller moving the detector to a plurality of angular positions with respect to the scene in response to the angular position of the radiation source.

10. (Previously withdrawn) The system of claim 9, wherein the radiation source and the detector are movable in a plane and the second motion controller maintains the detector in a predetermined position with respect to the radiation source, the predetermined position being located along a line in the plane that is perpendicular to the radiation source and the detector and that extends through approximately the center of the radiation source and the detector.

11. (Previously withdrawn) The system of claim 3 wherein the detector is mechanically coupled to the radiation source and the first motion controller moves the detector in conjunction with moving the radiation source.

12. (Previously withdrawn) The system of claim 3 wherein the scene is defined by a plurality of horizontal planes, and wherein the resolution controller varies the resolution of the detector as the detector is moved from a first angular position substantially parallel to the plurality of horizontal planes to a second angular position substantially perpendicular to the plurality of horizontal planes.

13. (Previously withdrawn) The system of claim 1 wherein the radiation source is a source of x-ray radiation.

14. (Previously withdrawn) The system of claim 13 wherein the radiation source emits a total radiation dose which is less than or approximately equal to a dose of a standard screening mammogram.

15. (Previously withdrawn) The system of claim 1, wherein the detector is a two-dimensional detector.

16. (Previously withdrawn) The system of claim 1, further comprising an exposure control system in electrical communication with the radiation source, the exposure control system controlling the intensity of the radiation emitted by the radiation source.

17. (Previously withdrawn) The system of claim 1, wherein the detector produces noise less than or equal to approximately a signal from 10 x-ray photons.

18. (Previously withdrawn) The system of claim 1, wherein the detector produces noise less than or equal to approximately a signal from 1 x-ray photon.

19. (Previously withdrawn) The system of claim 1, wherein the scene is a three-dimensional scene and wherein the resolution controller controls the detector to produce high resolution radiation transmission data for two dimensions of the three-dimensional scene and low resolution radiation transmission data for a third dimension of the three-dimensional scene.

20. (Currently Amended) A method for imaging a scene, comprising the steps of

irradiating a scene from a plurality of angular positions,

detecting radiation transmitted through the scene at a plurality of different spatial resolutions corresponding to the plurality of angular positions;

producing <u>two-dimensional</u> transmission data representative of the intensity of the radiation transmitted through the scene at each of the plurality of angular positions; and

producing a[n] <u>three-dimensional</u> image of the scene <u>based on said two-dimensional transmission data.</u>

21. (Original) The method of claim 20, wherein the step of irradiating the scene further comprises the step of irradiating the scene using x-ray radiation.

22. (Original) The method of claim 21, wherein the step of irradiating the scene further comprises the step of irradiating the scene using a total radiation dose which is less than or approximately equal to a dose of a standard screening mammogram.

23. (Original) The method of claim 22, wherein said standard dose is approximately 80 mrad per image.

24. (Original) The method of claim 20, wherein the plurality of angular positions forms an arc about the scene.

25. (Original) The method of claim 24, wherein the arc spans a plane and has an axis of rotation on a line in the plane that is perpendicular to the scene and that extends through approximately the center of the scene.

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26. (Original) The method of claim 20, wherein the step of irradiating the scene further comprises the step of varying the angular spacing between the plurality of angular positions.

27. (Original) The method of claim 20, wherein the scene is a three-dimensional scene and wherein the step of producing radiation transmission data further comprises the steps of:

producing high resolution radiation transmission data for two dimensions of the scene; and

producing low resolution radiation transmission data for a third dimension of the scene.

28 - 34. (Cancelled)

35. (Currently Amended) A method of imaging an object, comprising the steps of:

irradiating the object from a plurality of non-uniformly distributed angular positions,

detecting radiation transmitted through the object for each of said angular positions to create <u>two-dimensional</u> transmission data; and

constructing a[n] <u>three-dimensional</u> image of the object by analyzing said radiation transmission data.

36. (Original) The method of claim 35, wherein said angular positions are selected to define an arc about the object.

37. (Original) The method of claim 35, wherein the step of irradiating includes selecting a total radiation dose delivered to the object to be approximately equal to a dose of a standard screening mammogram.

38. (Original) The method of claim 35, wherein the step of irradiating includes irradiating the object with a first radiation dose at one angular position of the source and irradiating the object with a second radiation dose at another angular position, said second radiation dose being different from said first radiation dose.

39. (Currently Amended) A method of imaging an object, the method comprising the steps of:

irradiating the object multiple times, each irradiation being performed at a position angularly displaced from a previous irradiation position, said angular positions being non-uniformly distributed about the object;

detecting radiation transmitted through the object at each of said angular positions to create two-dimensional radiation transmission data; and

constructing a[n] three dimensional image of the object by analyzing said transmission data.

40. (New) The method of claim 37, wherein the step of irradiating the object comprises selecting a sufficiently low dose of radiation for each angular irradiation such that a total dose of radiation per three-dimensional image is approximately 80 mrad.

41. (New) The method of claim 39, wherein the step of irradiating the object comprises selecting each irradiation dose to be sufficiently low such that total dose of radiation per three-dimensional image is approximately 80 mrad.

42. (New) A method of imaging an object, comprising the steps of:

irradiating the object from a plurality of non-uniformly distributed angular positions,

detecting radiation transmitted through the object for each of said angular positions at a different spatial resolution to create a two-dimensional radiation transmission data; and

constructing a three-dimensional image of the object by analyzing said transmission data.

43. (New) A method of imaging an object, the method comprising the steps of:

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irradiating the object multiple times, each irradiation being performed at a position angularly displaced from a previous irradiation position, said angular positions being non-uniformly distributed about the object;

detecting radiation transmitted through the object at each of said angular positions at a different spatial resolution to create a two-dimensional radiation transmission data; and

constructing a three-dimensional image of the object by analyzing said radiation transmission data.